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angle to said corrugated pattern on an adjacent, second plate,] elements, wherein when said heat transfer package is in an unfolded state, a pattern of ridges and channels of a first planar element is generally aligned with respect to a pattern of channels and ridges of a successive planar element, and

wherein [said angle of] when said heat transfer package is in a folded state, said pattern on every other planar element is co-extensive to the other and said ridges and channels between facing sides of adjacent [plates] planar elements form a crossing pattern to each other such that said crossing pattern creates a flow resistance to said respective fluid medium flowing over said respective side of said [plate] planar element such that [the flow] a resistance to flow of each fluid medium is greater in said lengthwise direction of said [packing] heat transfer package than said widthwise direction, thereby increasing flow turbulence and heat transfer.

REMARKS

Claim 5 was rejected under 35 U.S.C. § 103(a) as being unpatentable over *Hultgren* in view of *Usher*, further modified by *Seidel*. *Hultgren* was said to disclose all the claimed limitations except the ridges and channels forming at least a 45 degree angle with respect to the length of the plate nor inlet and outlet ports disposed at a 45 degree angle with respect to the corners. *Usher* was said to disclose a heat exchanger for two fluids comprising a plurality of rectangular plates (Figures 3 and 4); wherein the angle of the ridges and channels are 30 degrees with respect to the width of the plate (i.e. 60 degrees with respect to the length of the plate) for the purpose of improving heat exchange (Page 3, lines 31-49).

Seidel was said to disclose a heat exchanger for two fluids comprising a plurality of rectangular plates 12; and inlet and outlet ports 20, 20' and 22, 22' (Figure 12) arranged at 45 degree angles with respect to the corners for the purpose of achieving a desired flow characteristic.

The Examiner claims that since *Hultgren* and *Usher* are both from the same field of endeavor, the purpose disclosed by *Usher* would have been recognized in the pertinent art of *Hultgren*, and since *Hultgren* and *Seidel* are both from the same field of endeavor, the purpose disclosed by *Seidel* would have been recognized in the pertinent art of *Hultgren*.

The Examiner then concluded that it would have been obvious at the time the invention was made to a person having ordinary skill in the art to employ in *Hultgren* ridges and channels having an angle of 60 degrees with respect to the length of the plate for the purpose of improving heat exchange as recognized by *Usher*, and employ in *Hultgren* inlet and outlet ports arranged at 45 degree angles with respect to the corners for the purpose of achieving a desired flow characteristic.

With respect to the amendments and remarks within Applicant's last Amendment, the Examiner comments that *Hultgren* discloses fold lines 27, and the angle between the corrugations of adjacent plates may be 90 degrees (Column 3, lines 24-30); and that the secondary reference of *Usher* discloses the angle of the corrugations may be changed to achieve desired heat exchange characteristics. He then claimed that the device of the combination of references as a whole is similar to the claimed instant invention and is believed to function in a similar manner.

The Applicant has carefully considered the Examiner's reasons for rejection and has amended the claims accordingly. For the following reasons, the Applicant believes the amended claims are distinguishable over the cited references and are therefore allowable.

First of all, the Examiner's assessment that *Hultgren* discloses all of the claimed limitations except the angle of the present ridges and channels, as well as the inlet/exit ports is overly encompassing.

Hultgren does not disclose a heat exchange element which has a pattern formed across the entire element. Furthermore, the present heat exchange package is oriented inside the casing such that the lengthwise direction of each element is exposed to the respective fluid medium. *Hultgren* on the other hand, leaves both end portions of each

heat exchange element free of profiles in order to form the inlet/outlet boxes for the flow mediums. In addition, *Hultgren* prefers that the angle of inclination of the ridged pattern be 20° or less, preferably around 5° . This low approach angle is instrumental in that exchanger accomplishing its recirculation effect by not reaching turbulent flow.

The present invention on the other hand, teaches away from never reaching turbulent flow, since the orientation of the heat exchange package and the angle of inclination of the corrugated pattern causes turbulent flow, where the lengthwise flow component is higher in turbulence and friction than the widthwise component, thereby improving heat exchange. *Hultgren* claims its non-turbulent design improves heat exchange by recirculation of portions of the flow stream, while the present design results with improved heat exchange through increasing the travel time in the lengthwise direction by providing a pattern which promotes additional friction and turbulence in that direction of flow.

The *Usher* reference might be said to disclose a plate having an angle where the ridges and channels are 30° respective the width direction, however, when considering the invention on a whole, the *Usher* reference is not of a continuous nature and requires holes in every other plate as a means of letting the fluids to enter each side of the heat exchange plates. Furthermore, flow direction of *Usher* is meant to change direction along the individual sheets comprising the exchanger package, such that the flow pattern from one plate to the next is changed. This results with uneven flow distribution from plate to plate at the expense of creating more turbulence as a means of increasing the heat transfer coefficient. The present heat exchanger design and orientation on the otherhand requires flow to proceed along the length of each sheet in the same direction, such that the two mediums are proceeding on each side of a sheet in exactly the same manner, thereby balancing the flow distributions as a means of maximizing heat transfer.

None of the references, either alone or in combination, show a continuous heat exchange package element where the pattern is formed on the entire planar element and which orientates the package such that the flow distribution is balanced on each side of

an element due to the flow having a higher flow friction in the lengthwise direction than in the widthwise direction.

For the above reasons, the Applicant believes the claims as amended are now in an allowable condition. Reconsideration and allowance is respectfully requested.

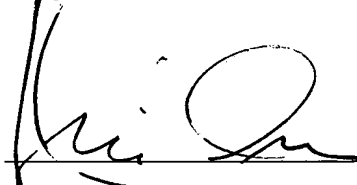
REQUEST FOR EXTENSION OF TIME

Applicant petitions the Commissioner of Patents and Trademarks to extend the time for response to the Office Action dated October 20, 1998, for three months, from January 20, 1999, to April 20, 1999.

Submitted herewith is a check for \$870 to cover the cost of the extension.

Any deficiency or overpayment should be charged or credited to Deposit Account No. 04-2219, referencing our Docket No. C-35620.

Respectfully submitted,



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